

Appl. No. 09/651,924
Amdt. dated May 31, 2005
Reply to Office action of March 2, 2005

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently amended) A multi-processor computer system, comprising:
a plurality of processors, each processor coupled to at least one memory cache, one cache control unit, and one interprocessor router; and
a memory coupled to each processor, each memory managed by a memory controller configured to accept memory requests from the plurality of processors;

wherein the memory requests from a local processor are delivered to the memory controller by the cache control unit and wherein memory requests from other processors are delivered to the memory controller by the interprocessor router and wherein the memory controller allocates the memory requests from the plurality of processors in a shared buffer using a credit-based allocation scheme in which the memory controller automatically returns a credit if a number of filled spaces in the shared buffer is below a threshold, but waits to return a credit when the number of filled spaces exceeds said threshold.

2. (Currently amended) The computer system of claim 1 wherein:
the cache control unit and the interprocessor router are each assigned a number of credits;
at least one of said credits must be delivered by the cache control unit to the memory controller when a memory request is delivered by the cache control unit to the memory controller; and
at least one of said credits must be delivered by the interprocessor router to the memory controller when a memory request is delivered by the interprocessor router to the memory controller;

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wherein if the number of filled spaces in the shared buffer is below [[a]] the threshold, the buffer returns the credits to the source from which the credit and memory request arrived.

3. (Currently amended) The computer system of claim 2 wherein:

wherein if the number of filled spaces in the shared buffer is above [[a]] the threshold, the buffer holds the credits and returns a credit in a round-robin manner to a source from which a credit has been received only when a space in the shared buffer becomes free; and

wherein if a source has no available credits, that source cannot deliver a memory request to the shared buffer.

4. (Original) The computer system of claim 2 wherein:

the number of credits assigned to the cache control unit and the interprocessor router is sufficient to enable each source to deliver an uninterrupted burst of memory requests to the buffer without having to wait for credits to return from the buffer.

5. (Original) The computer system of claim 4 wherein:

the number of credits available in the cache control unit and the interprocessor router are stored and updated in counters located in the cache control unit and the interprocessor router; and

the number of credits spent by the cache control unit and the interprocessor router are stored and updated in counters located in the shared buffer.

6. (Original) The computer system of claim 4 wherein:

the threshold is the point when the number of free spaces available in the buffer is equal to the total number of credits assigned to the cache control unit and the interprocessor router.

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7. (Currently amended) A computer processor for use in a multi-processor system, comprising:

an associated memory;

a memory controller comprising a request buffer in a front-end directory in-flight table;

an L2 data cache;

an L2 instruction and data cache control unit configured to send request and response commands from the processor to the memory controller; and

an interprocessor and I/O router unit configured to send request and response commands from remote processors to the memory controller;

wherein the L2 instruction and data cache control unit and interprocessor and I/O router unit are assigned a number of credits to be used by said processor and said remote processors and are configured to give up a credit to the directory in-flight table each time a request or response command is sent to the request buffer and wherein if the request buffer is filled below a buffer threshold, the directory in-flight table immediately returns credits to the source from which the credit was received, and if the request buffer is filled above the buffer threshold, the directory in-flight table holds on to a credit and returns said credit upon an entry in the request buffer becoming free.

8. (Currently amended) The computer processor of claim 7 wherein:

~~if the request buffer is filled above a buffer threshold, the directory in-flight table holds credits and returns a credit to a source from which a credit was received only when a buffer space is emptied; and~~

wherein if a source has no available credits, that source may not send a request or response command to the request buffer and wherein if a source has one available credit, that source may only send a response command to the request buffer.

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9. (Original) The computer processor of claim 8 wherein:
the credits are returned to the sources which have given up credits to the directory in-flight table in a random, equally probably manner.
10. (Original) The computer processor of claim 8 wherein:
the buffer threshold is the point above which the number of empty spaces in the request buffer is equal to the total number of credits assigned to the L2 instruction and data cache control unit and interprocessor and I/O router.
11. (Original) The computer processor of claim 8 wherein the directory in-flight table further comprises:
a counter to store and update the number of credits spent by the L2 instruction and data cache control unit;
a counter to store and update the number of credits spent by the interprocessor and I/O router; and
a counter to store and update the number of empty spaces in the request buffer when the request buffer is filled above the buffer threshold;
wherein when the request buffer is filled above the buffer threshold, the directory in-flight table holds credits and returns credits only when the number of empty spaces in the buffer increases.
12. (Original) The computer processor of claim 8 wherein:
the number of credits available to the L2 instruction and data cache control unit and interprocessor and I/O router is stored and updated by counters in each unit.
13. (Original) The computer processor of claim 8 wherein:
the number of credits available to the L2 instruction and data cache control unit and interprocessor and I/O router is determined by the round trip time required to send a credit to and receive a credit from the directory in-flight table;

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wherein the number of credits given to each source is sufficient to allow each source to send an uninterrupted sequence of request or response commands to the directory in-flight table without delays caused by waiting for credits to return from the directory in-flight table.

14. (Previously presented) A method of allocating space in a shared buffer, comprising:

assigning credits to each of a plurality of sources that sends data packets to the shared buffer; and

requiring each source to spend a credit each time that source sends a data packet to the shared buffer;

wherein if the number of empty buffer spaces is larger than a buffer threshold, automatically paying the credit back to the source from which the credit and data were sent; and

wherein if the number of empty buffer spaces is smaller than the buffer threshold, holding the credit until a buffer space becomes empty and then paying a credit back to a source from which a credit was sent.

15. (Previously presented) The method of claim 14, wherein:

when the number of empty buffer spaces is smaller than the buffer threshold and a buffer space becomes empty, automatically returning a credit in a random, equally probable manner to one of the sources which have spent credits held by the buffer.

16. (Previously presented) The method of claim 14, wherein:

when the number of empty buffer spaces is smaller than the buffer threshold and a buffer space becomes empty, automatically returning a credit in a random, statistically skewed manner to one of the sources which have spent credits held by the buffer.

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17. (Original) The method of claim 14, further comprising:
assigning a minimum number of credits to each source that is sufficient to allow each source to send a continuous sequence of data packets without waiting for returned credits.
18. (Original) The method of claim 14, further comprising:
preventing a source from delivering a data packet to the shared buffer if that source has no available credits.
19. (Original) The method of claim 14, further comprising:
setting the buffer threshold equal to the number of total credits assigned to all the sources.
20. (Original) The method of claim 14, further comprising:
using a counter in each source and a counter for each source coupled to the buffer to track spent and paid back credits.
21. (Currently amended) A system, comprising:
a plurality of sources; and
a receiver;
a buffer accessible to said receiver;
wherein said receiver is adapted to receive requests from said sources,
the receiver comprising a controller that permits said sources to provide memory requests to said receiver based on credits issued by said receiver to said sources and that said receiver automatically issues a credit to a source if a number of filled spaces in said buffer is less than a threshold and holds on to a credit if the number of filled spaces is greater than the threshold ~~without the source having to request a credit.~~

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22. (Previously presented) The system of claim 21 wherein each credit corresponds to a single memory request.

23. (Previously presented) The system of claim 21 wherein the receiver further comprises a buffer adapted to receive a plurality of memory requests from said sources, and said credits are automatically issued to said sources to permit said sources to provide said requests to said buffer.

24. (Previously presented) The system of claim 21 wherein the receiver issues credits among said sources to avoid a source from having exclusive access to said receiver to the exclusion of the other sources.